Recreational Water Quality

Current Status and Opportunities

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Continuing concerns about nation's recreational waters

- Substantial inconsistency in monitoring approaches among and within states.
- Inconsistent public notification programs.
- Growing concerns about microbiological contaminants
- Increased pollution pressures on coastal and water-based areas due to population growth and more intense land use.

EPA BEACH Program

- Strengthen beach programs and water quality standards
- Inform public about recreational water quality
- Conduct research to improve science for beach programs

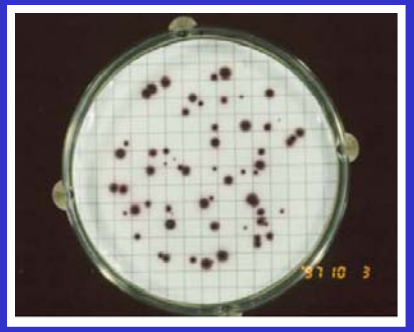
Criteria For Quality Indicator

- Relevance to health effects
- Source characterization
- Timely results
- Data confidence
- Beach specificity
- Economy, ease, effectiveness

EPA/CDC/USGS Pilot Epidemiological Study

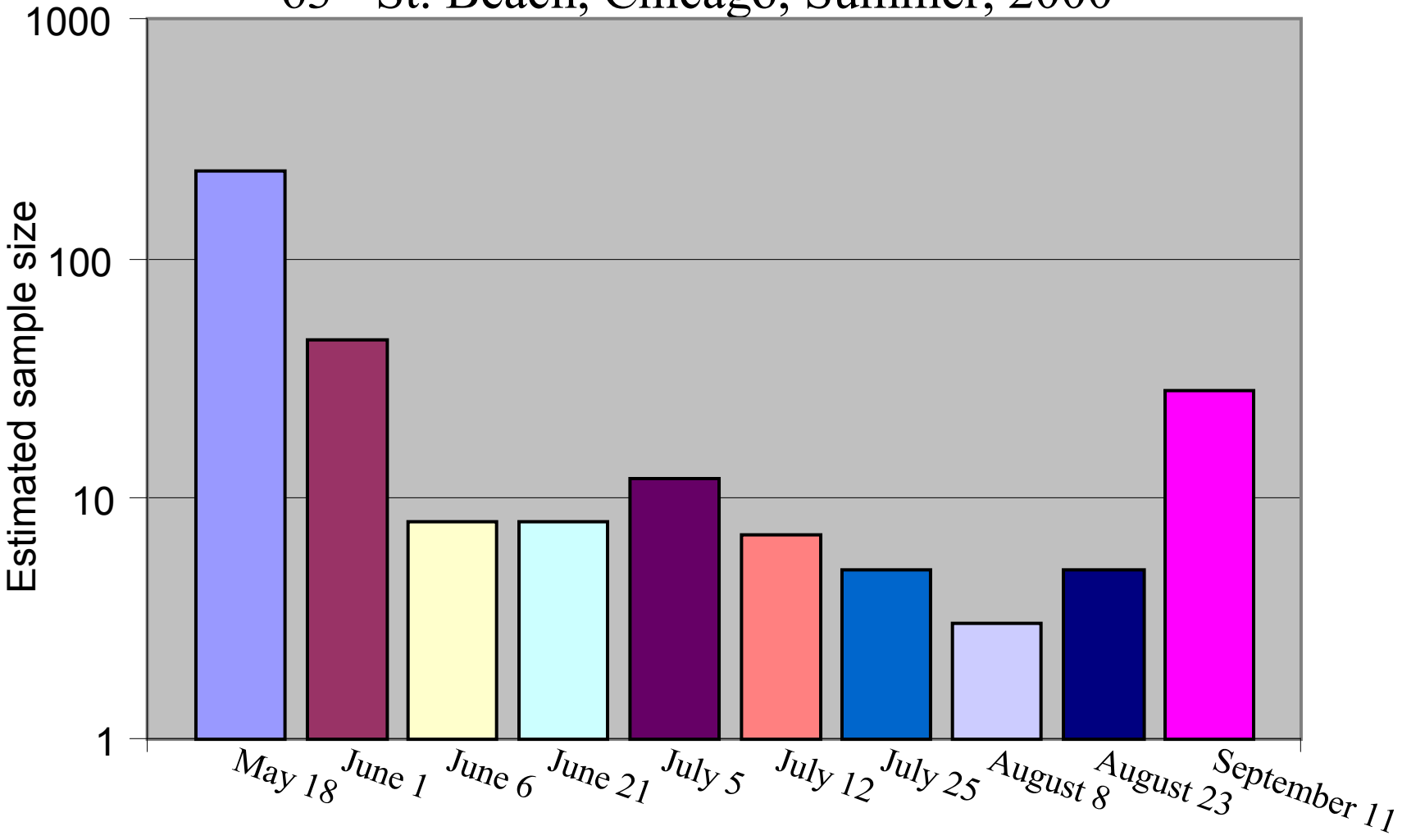
Beach Sampling Approach

- Test for *E. coli* or fecal coliform
- Samples generally taken
  - Morning
  - At shore or knee deep
  - From the surface
- Monthly, weekly, or daily
- Single sample per beach



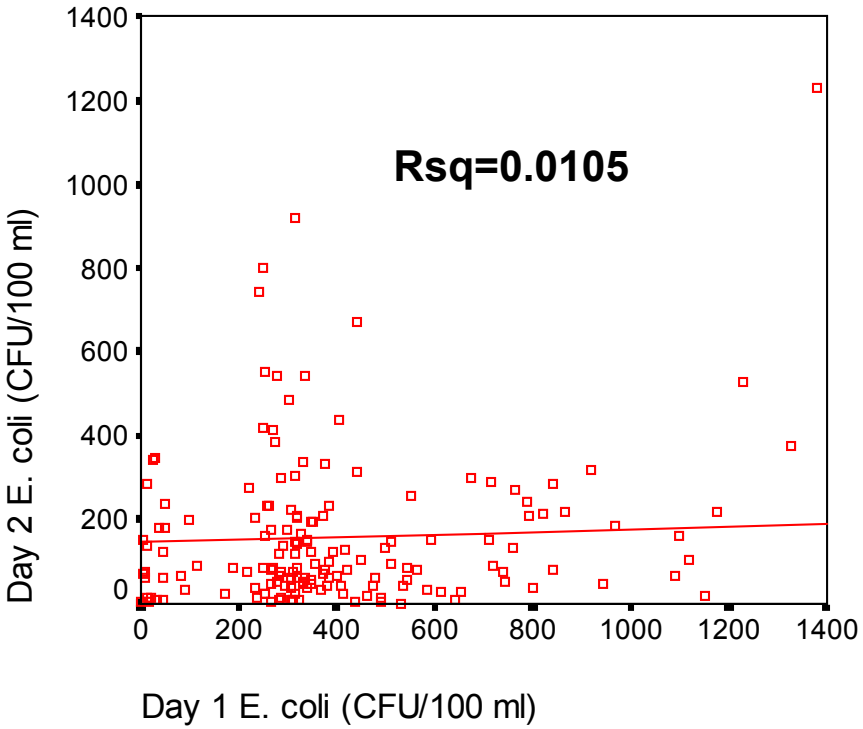
Sample Sizes Required to Achieve Precision ± 30% of the Mean

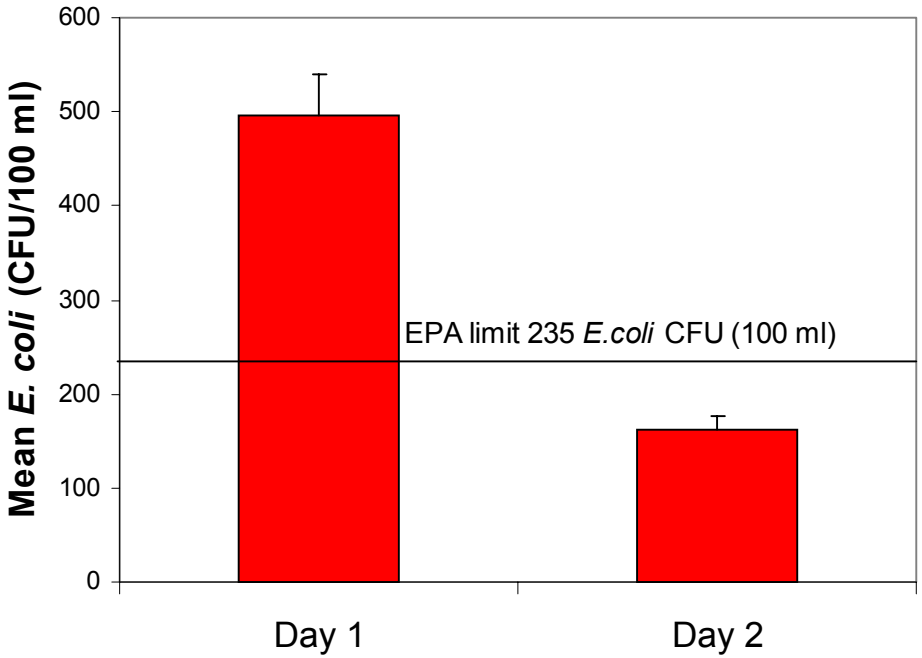
63rd St. Beach, Chicago, Summer, 2000



Based on ten replicate samples taken each day in AM at center transect, 90 cm. Estimates calculated using Elliot's (1977) equation for small sample size.

Day to Day Sampling of *E. coli* at Indiana Dunes National Lakeshore





Little Glen Lake, Sleeping Bear Dunes National Lakeshore (*E. coli* counts in CFU/100 ml)

583 ✖ 25 ft
620 ✖ 50 ft
0 ✖ 100 ft
2 ✖ 200 ft
1 ✖ 300 ft

✖ SW shore 0

NE shore 128 ✖

N

WIND

Correlations among Seagull numbers and *E. coli* concentrations

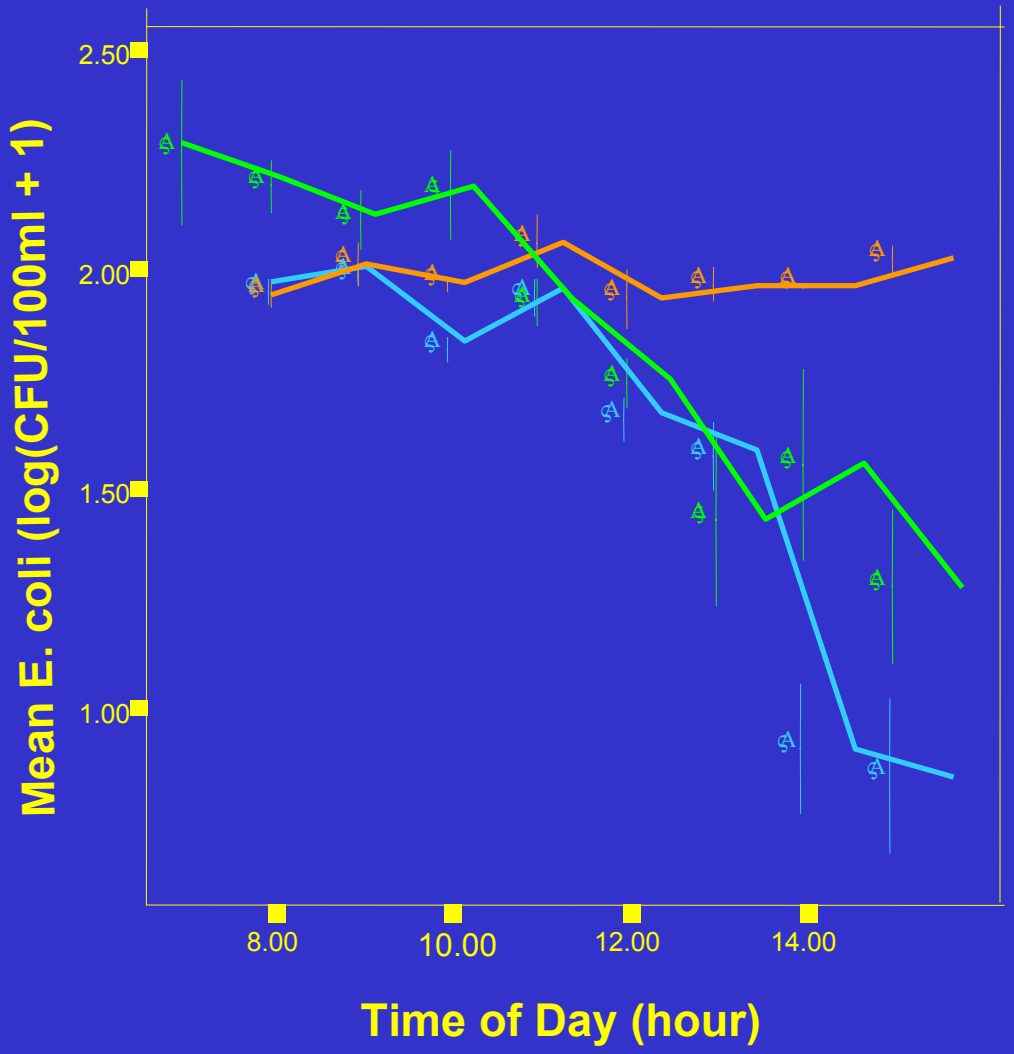
63rd St. Beach, Chicago, Summer 2000

	# gulls unlagged, P values	# gulls lagged 1 day, P values
Foreshore sand	0.133	0.000*
Submerged sand	0.972	0.046
45 cm water AM	0.224	0.004*
90 cm water AM	0.037	0.001*
45 cm water PM	0.916	0.167
90 cm water PM	0.432	0.008

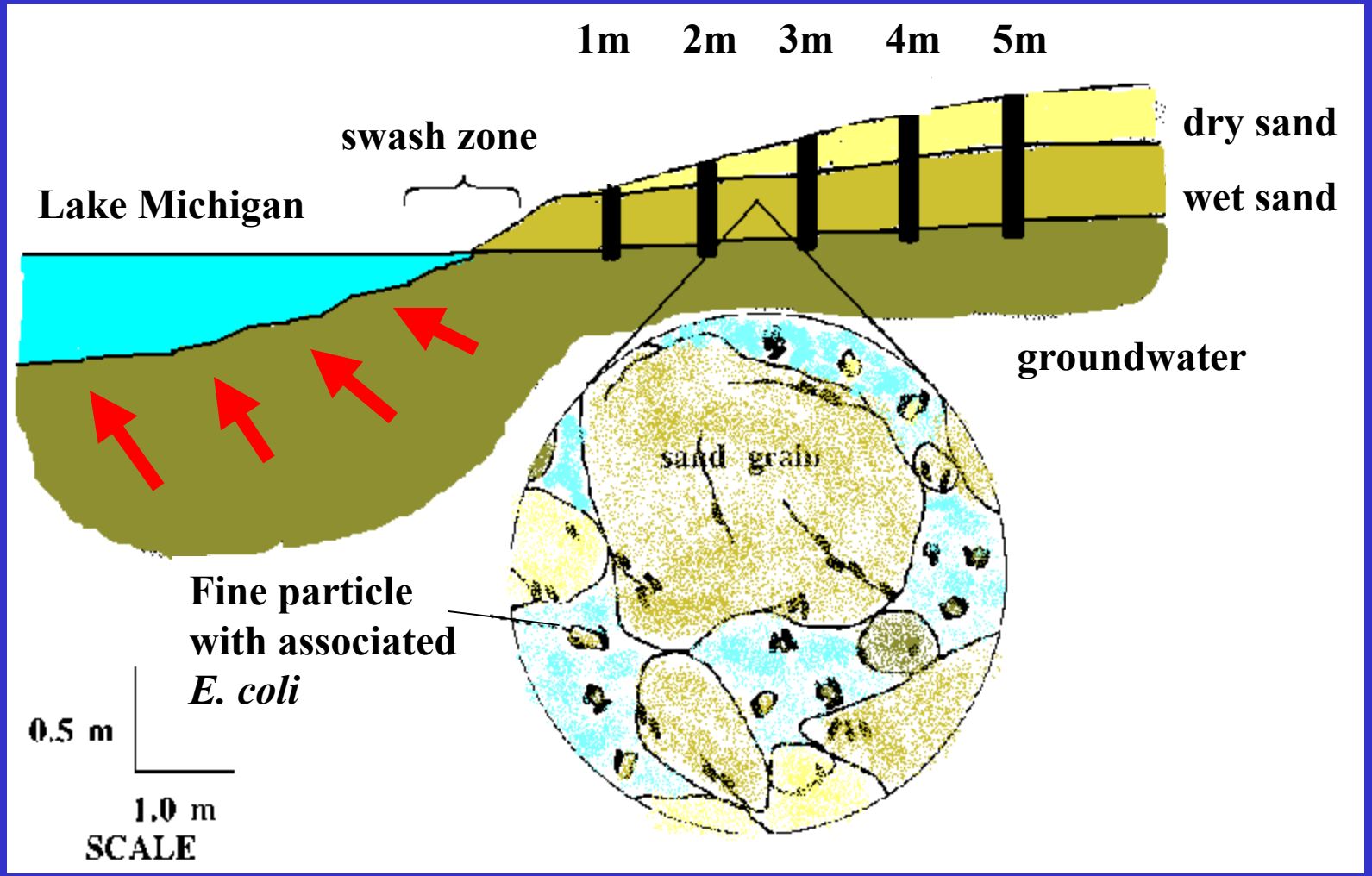
Critical p value Bonferroni corrected =0.006

Results of Light/Dark Bag Experiment

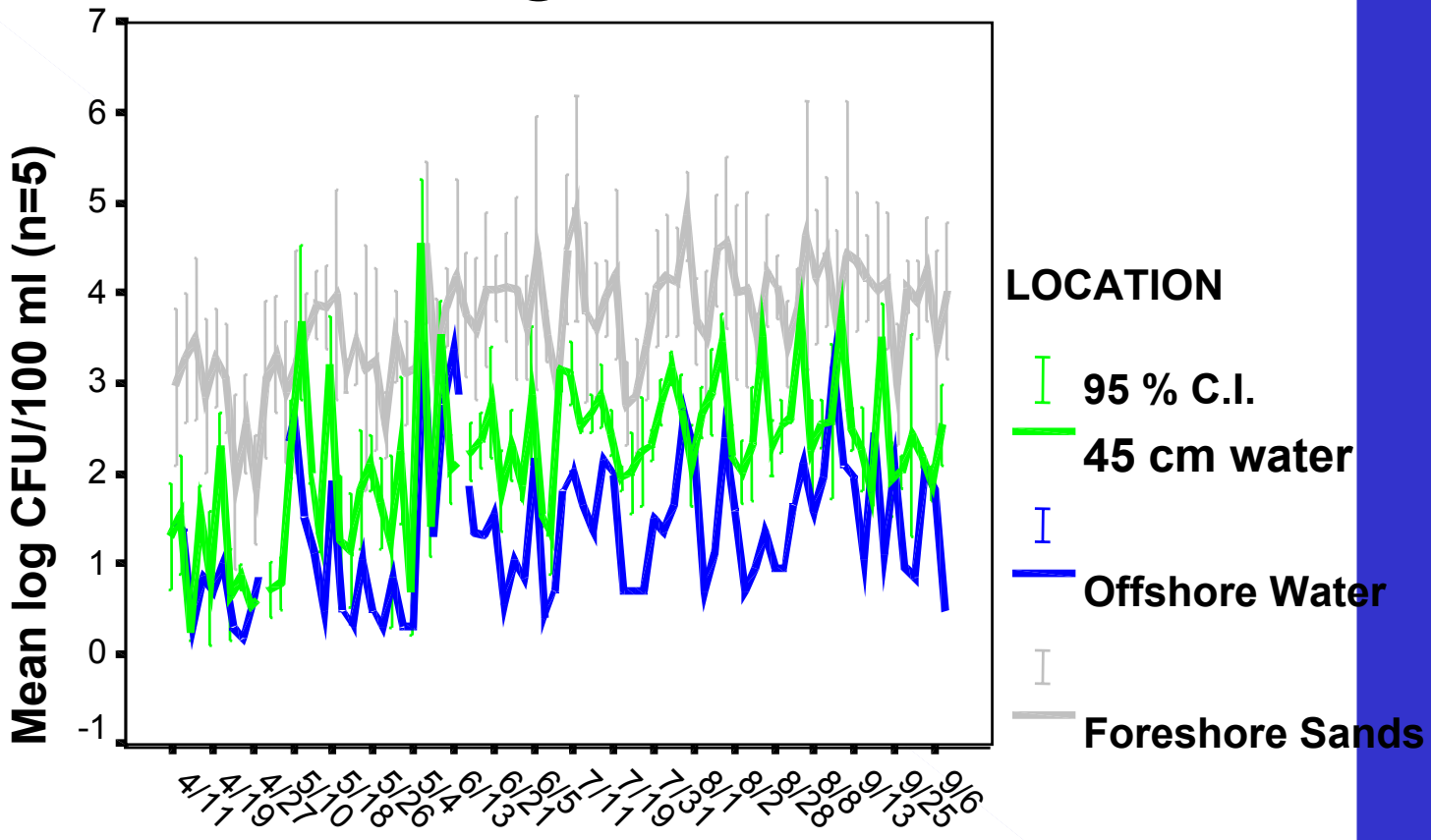
63rd St. Beach, Chicago
September 18, 2000



E. coli in Sand



E.coli in sand and water of 63rd St. Beach, Chicago, 2000

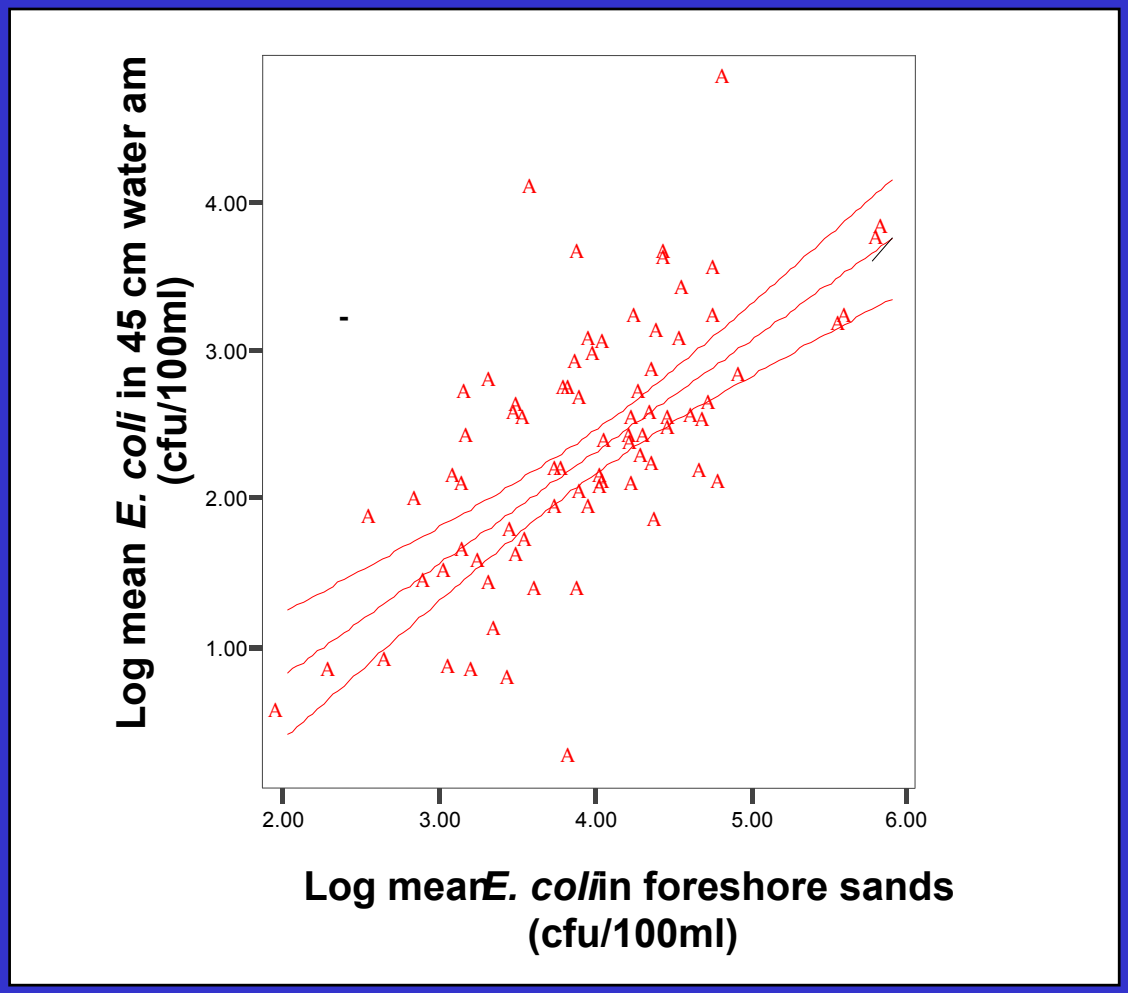


Partial R, 45cm water vs Shore Sand = 0.501**

Partial R Offshore vs Shore Sand = 0.259*

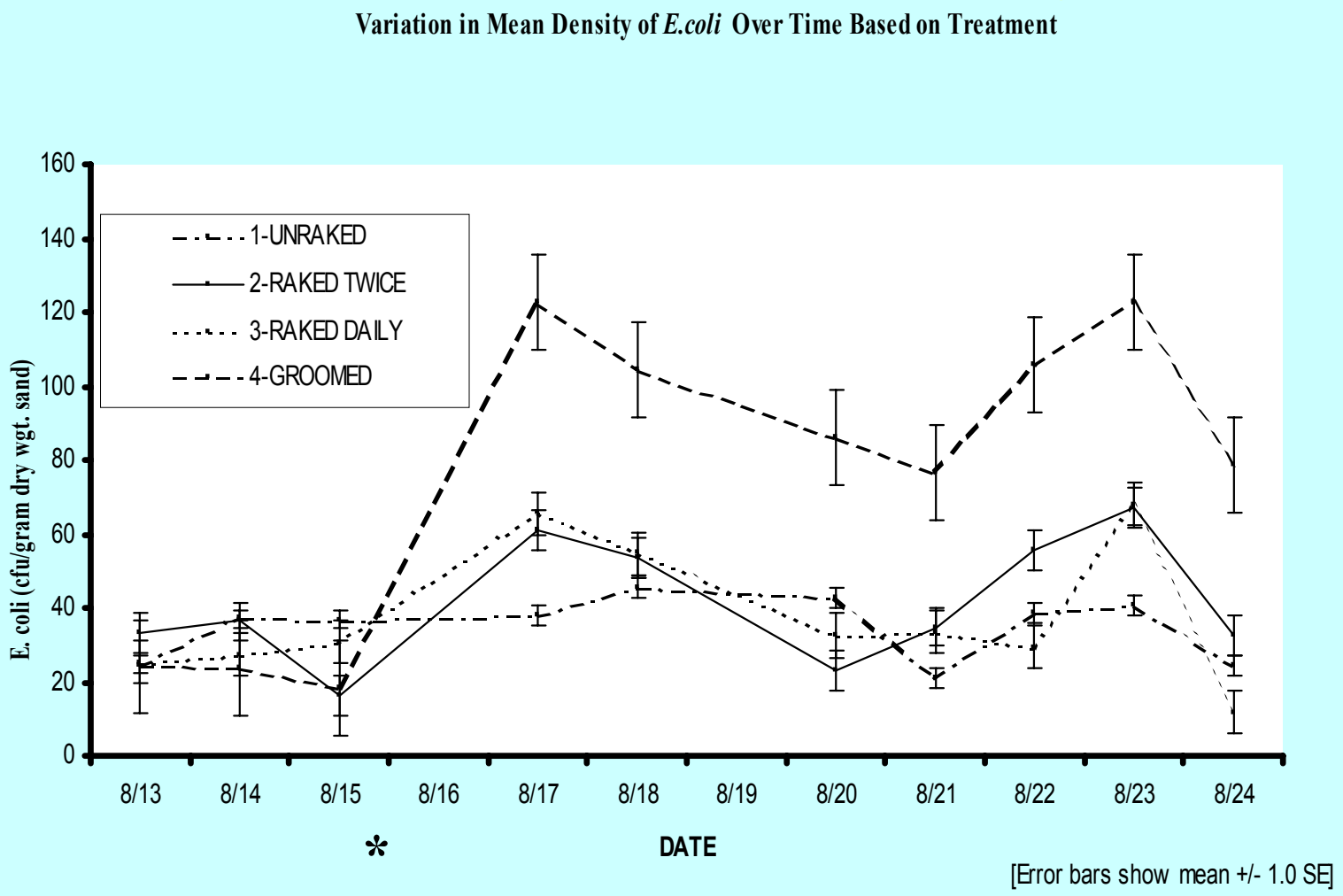
Linear regression of *E. coli* concentrations in sand and water

63rd St. Beach, Chicago, Summer, 2000



R sq. =0.43

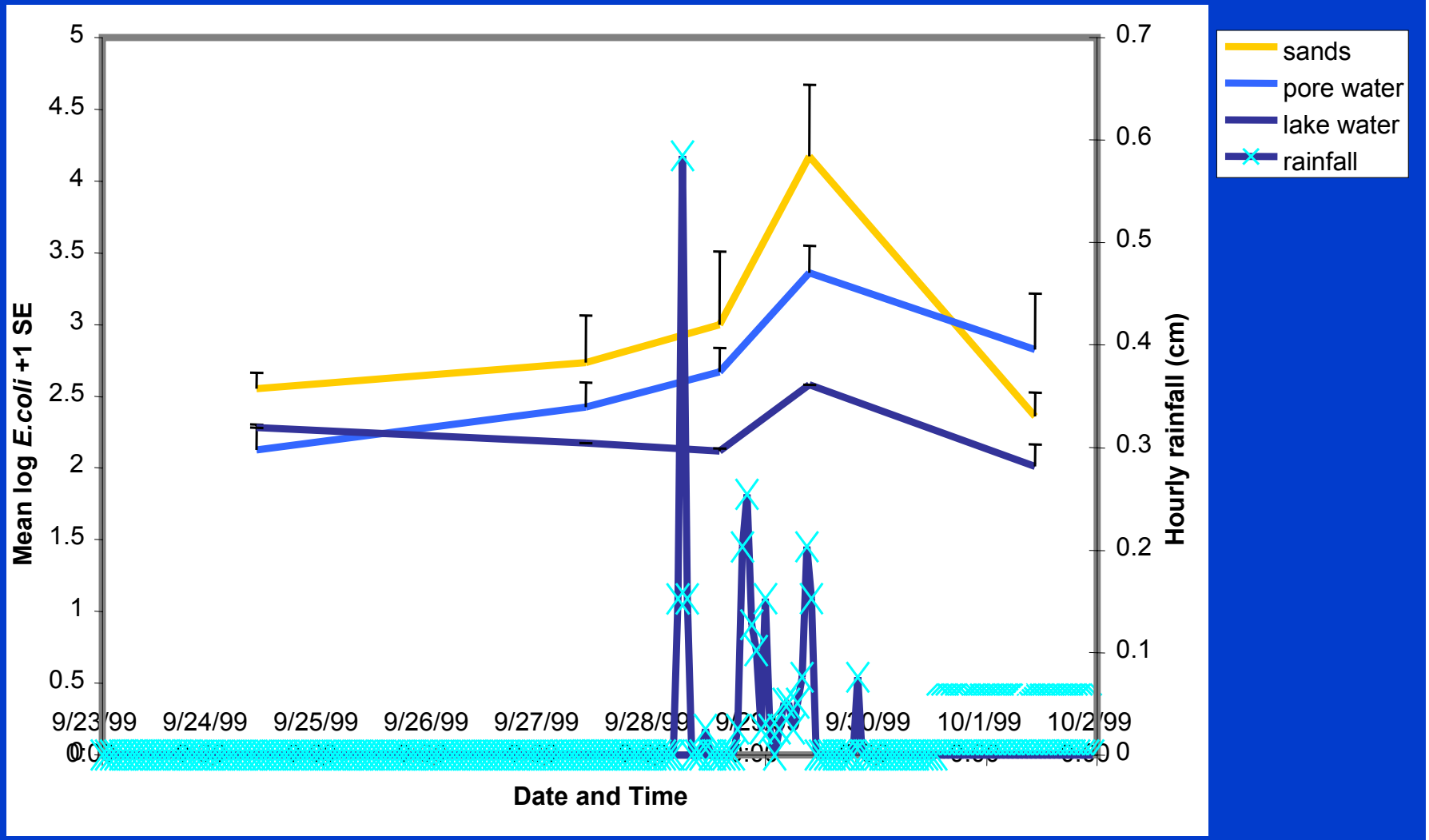
Variation in *E. coli* density-2001



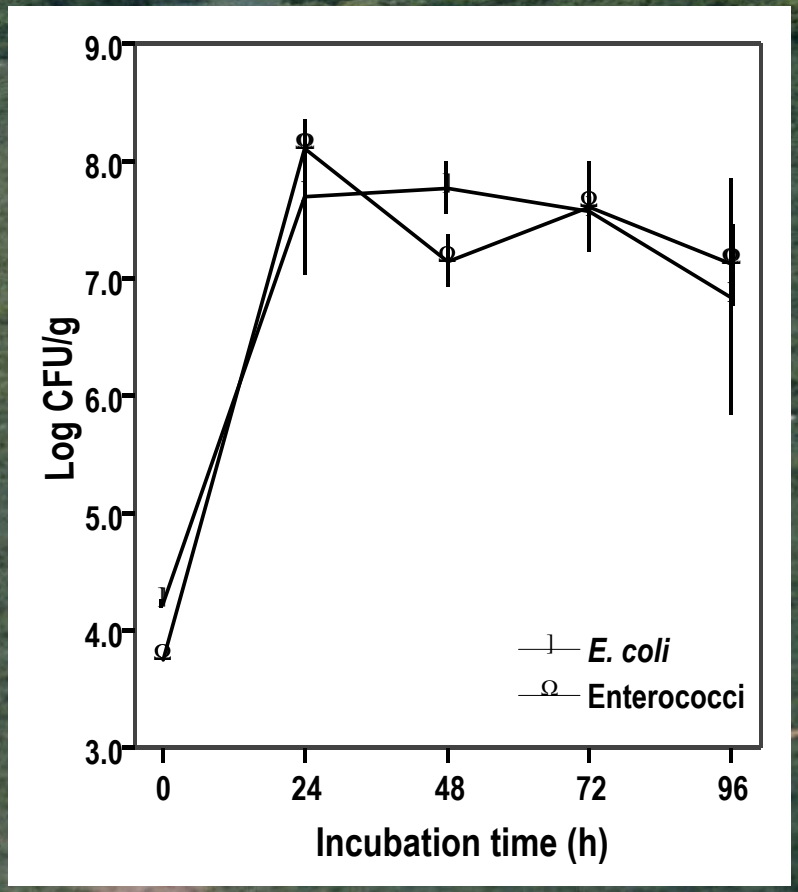
*** Rainfall event**

E. coli Concentration of Lake Water, Pore water and Sand with Rainfall

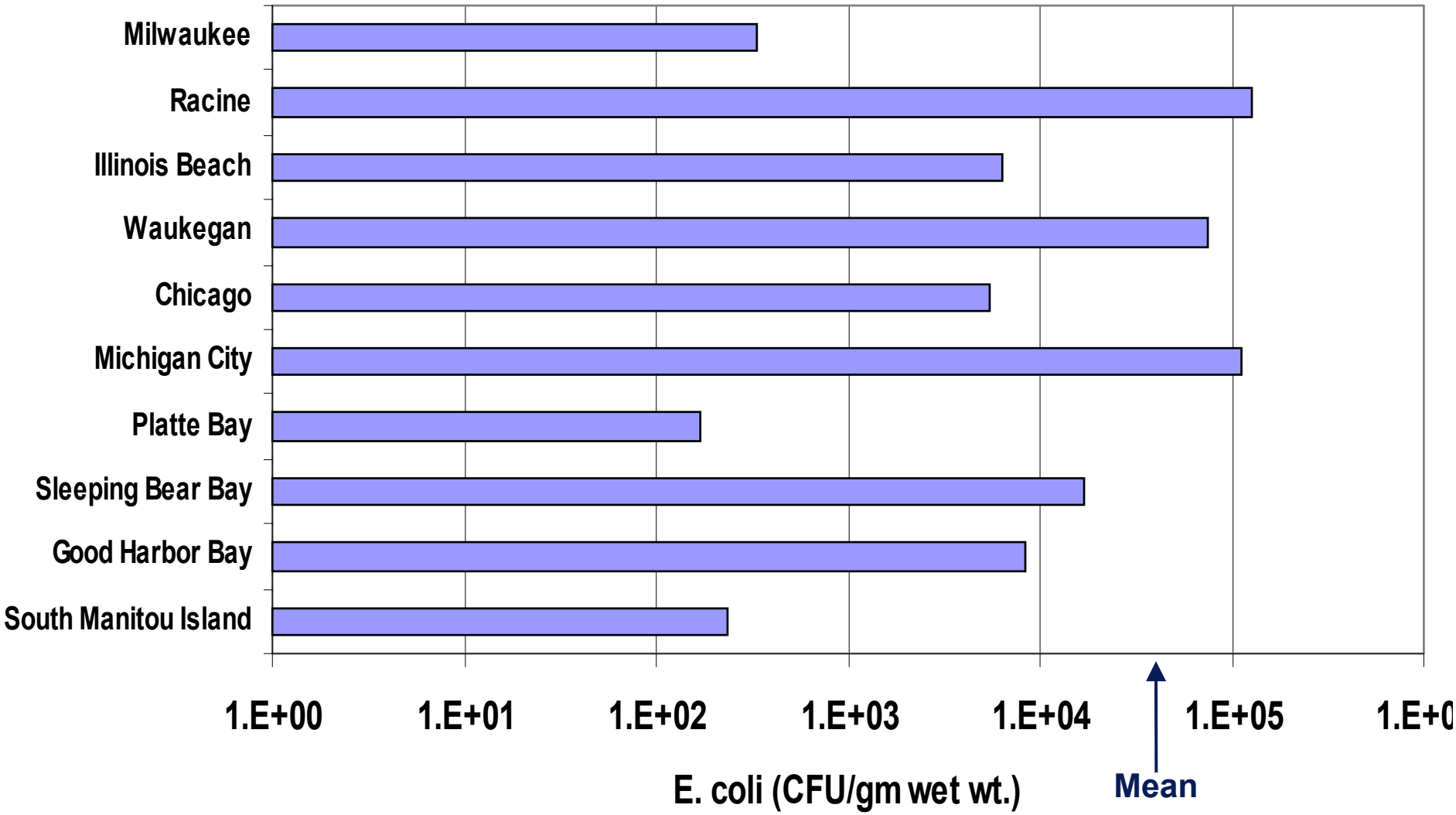
Lakeview Beach, Indiana Dunes National Lakeshore



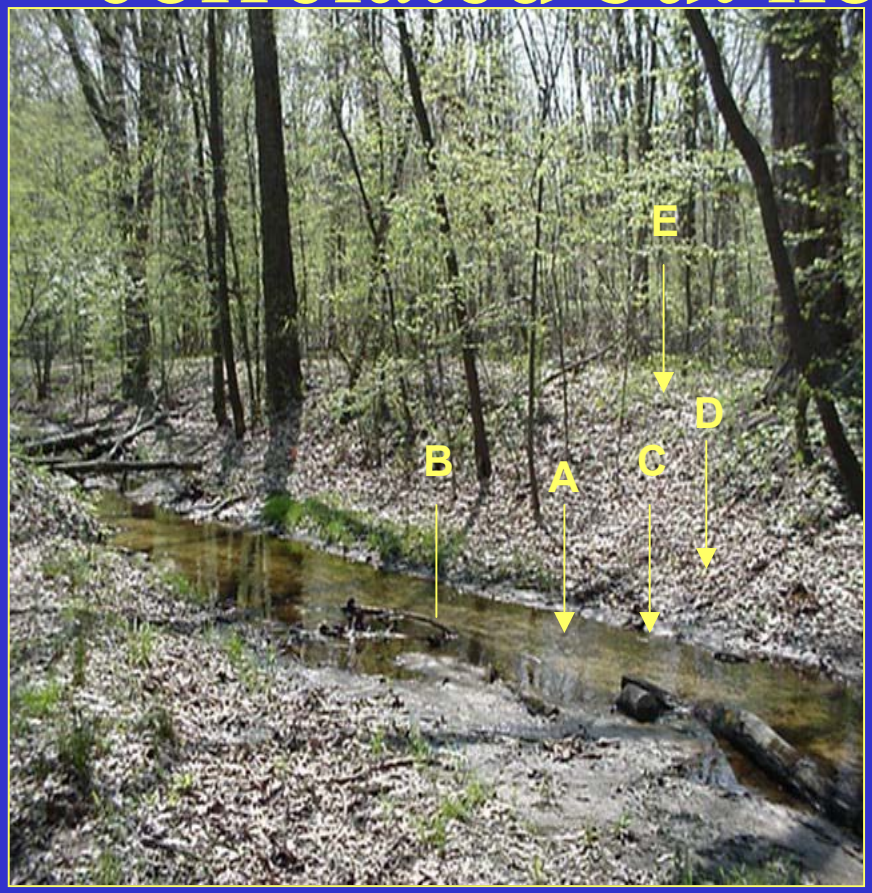
E. coli and enterococci persist in *Cladophora* mats



Concentration of *E. coli* washed from *Cladophora glomerata*



Stream water and sediments are correlated but not with forest soil

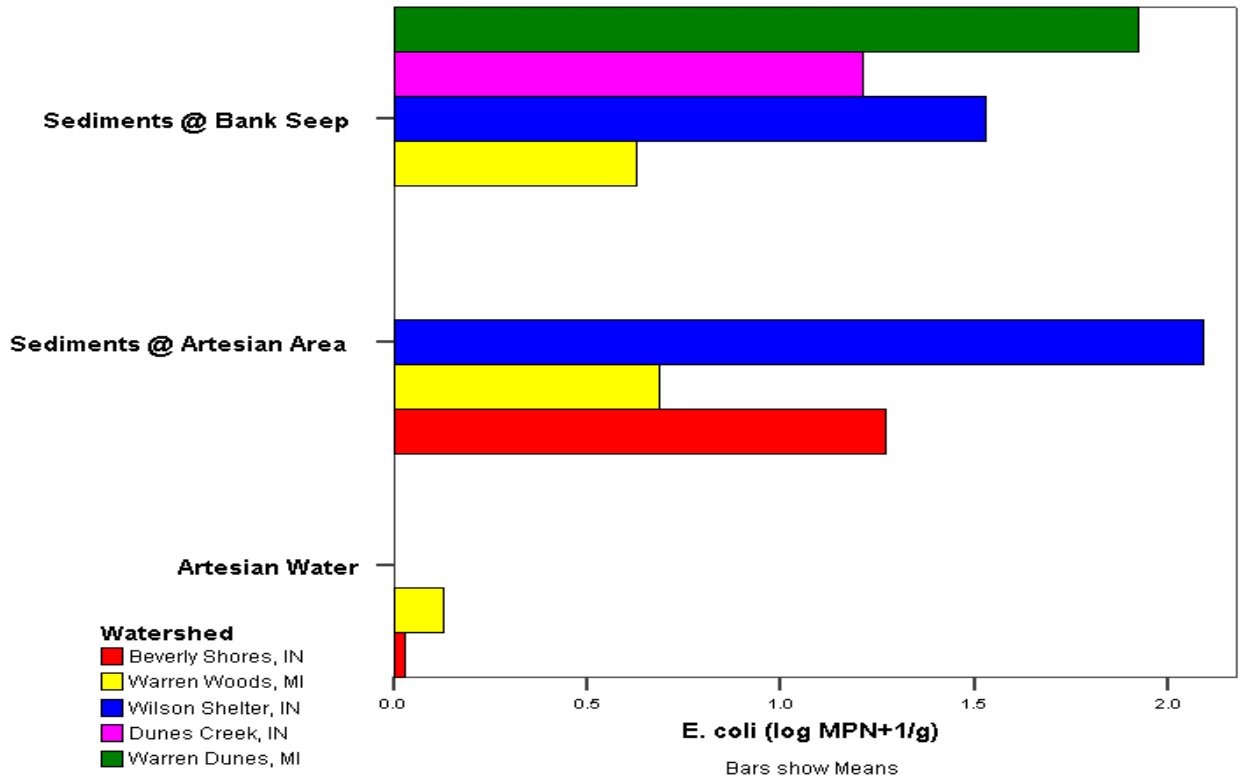


Stream Water-A
Stream Sand-B
Margin Sand-C
Sand @ 1 m from margin-D

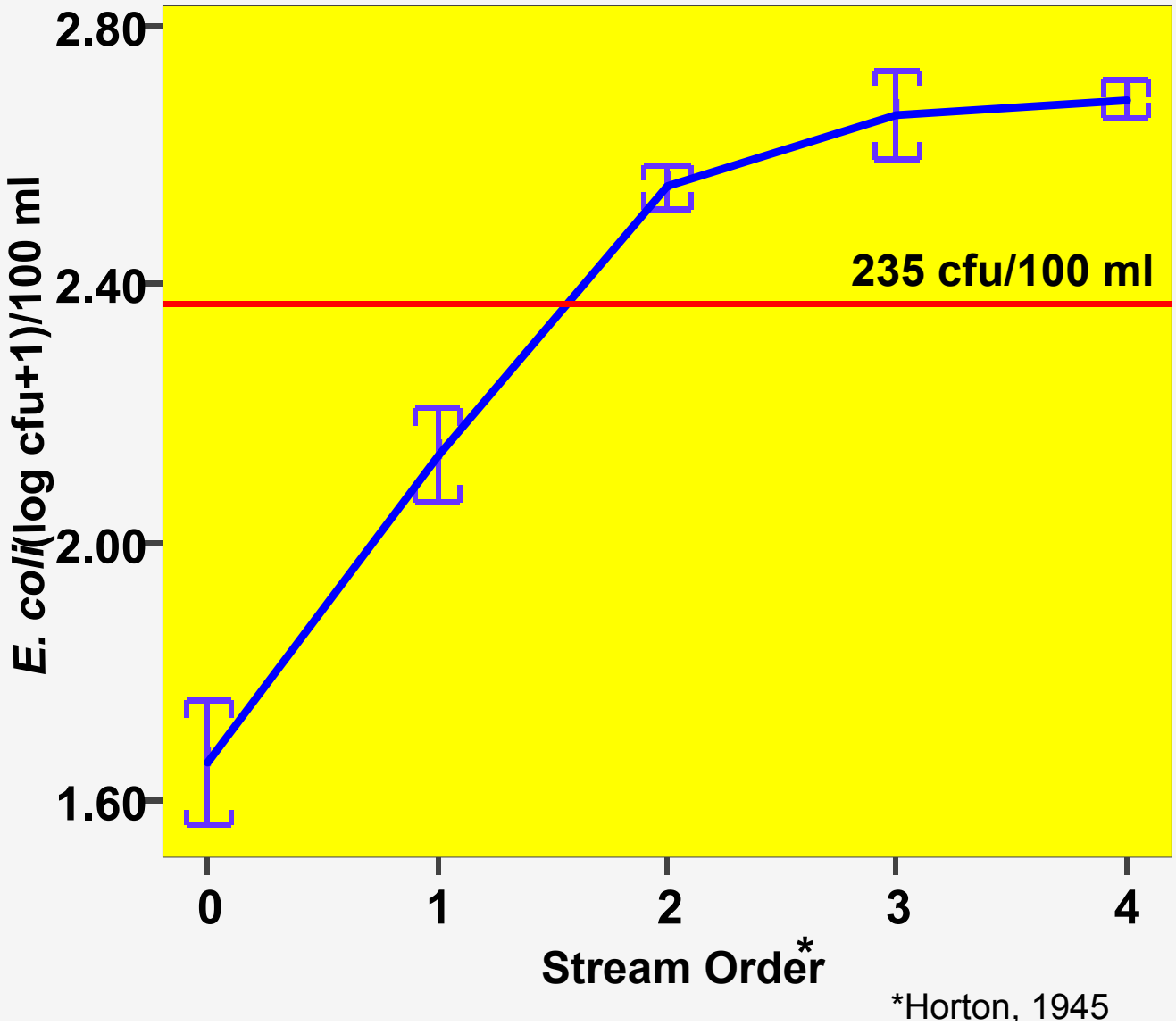
Soil @ 4 m from margin-E

Connected Lines Indicate Significant Correlation (Spearman rho, p=0.05, n=15)

E. coli is commonly found in sediments surrounding seeps and springs but not emanating water.



E. coli in Dunes Creek increases with stream order



General Forces

- Currents
- Sediments
- Orientation
- Weather
- Runoff

Local Forces

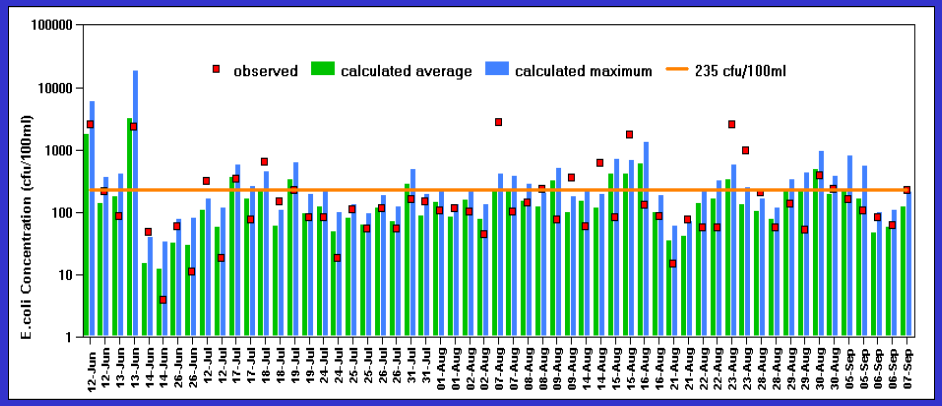
- Morphology
- Shoreline Exposure
- Sources
  - Direct (e.g. sewage, birds)
  - Indirect (e.g. sands, rivers, submerged storage)

Correlations among summer, 2000 *E. coli* concentrations at three Lake Michigan beaches

Pearson Correlation (2-tailed)		63rd Beach	North Beach
West Beach	r	0.564	0.386
	Sig.	0.002	0.047
	N	27	27
63rd Beach	r		0.552
	Sig.		0.003
	N		27

Future Directions

- Better notification
- More Timely Results
  - Faster tests
    - Chemical and Biological
  - Predictive models
    - Local and regional models
- More interjurisdictional cooperation
- Standardization



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